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(54) Stromversorgungseinrichtung mit verschiedenartigen, daran anschliessbaren Elektrowerkzeugen.

(57) Es wird eine Stromversorgungseinrichtung mit verschiedenartigen, über ein Verbindungskabel (16) mit einem Verbindungsstecker (22) daran anschließbaren Elektrowerkzeugen (10) vorgeschlagen. Diese Stromversorgungseinrichtung (13) enthält eine elektronische Steuervorrichtung (14) zur Steuerung der Elektrowerkzeuge (10) in Abhängigkeit wenigstens eines Parameters. Eine über die Verbindung zum Elektrowerkzeug (10) durch die elektronische Steuervorrichtung (14) abgreifbare, werkzeugspezifische Codierung stellt in der elektronischen Steuervorrichtung (14) ein entsprechendes Steuerverhalten für das jeweilige Elektrowerkzeug (10) ein. Durch die vorzugsweise im Verbindungsstecker (22) angeordnete Codierung kann ein einziger Typ einer Stromversorgungseinrichtung für verschiedene Elektrowerkzeuge verwendet werden, wobei sich das für das jeweilige Elektrowerkzeug erforderliche Arbeitsverhalten über die Codierung von selbst einstellt.

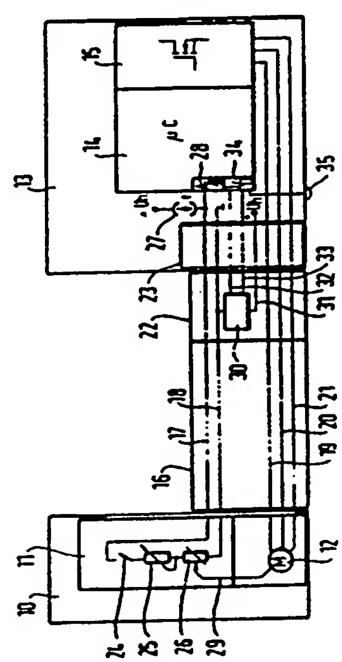

FIG. 1

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fficial use

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Your reference RRS/5480UK

Notes

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0304574

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PATENT NO EP (UK)......0304574

TRANSLATION OF EUROPEAN PATENT (UK) UNDER SECTION 77 (6) (a)

Date of Publication of the Translation...21 OCT 1992...................

European Patent Application No. 88109750.0

I, David James Bailey, of 167 Portreath Drive, Allestree, Derby, DE3 2SB, England, hereby declare that I am the translator of the documents attached and certify that the following is a true translation to the best of my knowledge and belief of European Patent No. 0304574 as accepted by the European Patent Office.

Signature of translator:

David J. Bailey

Dated this twentieth day of May 1992

Patent Specification

The invention relates to a power supply unit with various power tools connectable to it via a connection cable with a connector, and with an electronic control device in the power supply unit to control the power tools depending on one or more parameters

A power supply unit of this kind is known from DE-OS 32 47 046 or from DE-OS 37 09 983 for three-phase power tools. A three-phase current with a variable frequency of, for example, 0 - 400 Hz is generated in it for speed-dependent control of the power tool. Any desired number of power tools of various kinds can be alternately connected to this power supply unit via connection cables. The variation in speed can be set for example by means of a potentiometer on the power supply unit.

If power tools of very different kinds are connected to this power supply unit, there arises the problem that one power tool is operated at very low speeds, while another operates at very high speeds. In addition there is a multiplicity of other requirements, which differ for the various types of power tool. Thus for example there are different requirements for starting and braking patterns, load limitation, speed limitation, etc. While it is conceivable for these patterns to be set individually at the power tool or the power supply unit by means of potentiometers, switches or the like, with appropriate changes when another power tool is used, this is however time-consuming and complicated, in particular if a very large number of parameters or functions are to be changed. This would result in a need for different power supply units for very different power tools, leading to increased cost.

Known from EP-A-0 132 528 are tools for numerically-controlled machining centres in which tool-specific codings are read by means of an electric voltage signal via a connector to the tool, and appropriate control behaviour is set in the machining centre. The codes provided cover tool-specific parameters such as length, diameter and tool life.

A problem of the invention is therefore to create a power supply unit of the type described above, to which very different power tools can be connected, while the electrical operating characteristics desired in each case are set automatically without manual intervention.

This problem is solved according to the invention by the characterizin features of claim 1.

Immediately after the connection between the power tool and the power supply unit has been made, the desired tool-specific limit values and functions can be set automatically by the power supply unit in accordance with the scanned coding. By this means, a single power supply unit can be used for very different kinds of power tool, of different size, so that initial costs can be kept low. Adjustment to the particular machine is effected automatically, i.e. no laborious setting and adjustment is required, nor can any errors in setting occur.

Advantageous developments and improvements of the power supply unit defined in claim 1 are possible by adapting the measures described in the subsidiary claims.

The diverse coding options permit very specific adaptation to the type of tool concerned. Thus for example the coding device can be used to preset limit values for parameters such as speed, temperature torque, electric current, electric voltage, etc., and also control functions for the power tool concerned, such as speed range, starting and braking patterns, operating characteristics and the like.

Especially advantageous is the placing of the coding device in the connector of the connection cable to the power supply unit. The coding device could of course also be located in the power tool itself, but this would then necessitate additional leads in the connection cable and would make interchange of the coding device more difficult. In contrast, the connector can be exchanged very easily, so that a coding can also be applied subsequently. In additio to a mechanical coding device, an electrical coding device has proved to be particularly advantageous. In the simplest case, the coding device can be an analog, electrical device, realized by resistors in the connector. These resistors are expediently connecte on one side to an earth or neutral wire, while their other connectio is made to connection contacts of the connector. The resistance valu presetting the various coding functions are acquired by the electric control device via associated mating contacts in a corresponding coupling or counterplug. In order to acquire the resistance values, the mating contacts may preferably be connected to power sources, with the voltages read off at the mating contacts being supplied as

coding voltages of the electronic coding device. By this means, various codings can be made in a simple manner using different sets of resistors, leading to a very cost-effective coding system, with no problems in exchanging the coding connector in the event of a defect or a change in coding.

Also advantageous is a digital electrical coding device using a digital memory, also preferably located in the connector, but also locatable in the power tool. With design as a serial memory, the benefit of such coding lies above all in the fact that a very great number of different coding values or functions can be provided, with only two connection contacts and two mating contacts needed to acquire the coding, since the latter is read serially. This arrangement therefore permits very precise adaptation to the power tool concerned through a very diverse and detailed coding, while the cost hardly increases at all with a rise in the number of coding values and functions, so that digital coding of this kind is especially suitable for complex diverse codings.

Reading of the coding is expediently initiated by plugging in the connector, which incidentally also appears expedient for other types of coding. If an error occurs in reading of the coding, then the reading process is automatically repeated, with a visual or audible fault indication advantageously provided after a preset number of unsuccessful attempts. This can prevent the power tool operating in an uncontrolled manner due to faulty coding.

By designing the memory containing the coding as a read-write memory, in particular as E^2PROM, the coding can be altered without changing the hardware, with subsequent amendment also being possible, or the coding can even be stored subsequently. This permits, for example, the creation of integral connection cables and connectors for all the various types of power tool, while the coding need be implemented only when the power tool, complete with connection cable, has been produced. If the user desires a different coding for special applications of a power tool, for example different limit values, then the coding can easily be changed subsequently by amending the data in the memory of the connector.

Characteristic data such as equipment type, equipment number, date sold, owner or the like can be input before the power tool is sold, this simplifying guarantee, repair and other services. Such data can also prove useful in preventing theft or as evidence of ownership.

Also of advantage is the recording in this memory of fault signals during operation, so that suitable editing of malfunctions which occur can be effected in a known manner by a microcomputer in the power supply unit. During service or repair, the fault data can then be read out and a fault detected easily, in particular when it occurs only occasionally. Even concealed faults previously undetected by the user can be detected in this way and rectified, before any major damage occurs.

In order for example to permit adjustment of the speed of the power tool from the tool itself or to allow the undertaking of monitoring functions, the connection cable also has control lines in addition to power supply lines, with operation of the power tool being effected by one or more operating elements on the power tool via the control lines and the electronic control device in the power supply unit. Suitable operating and monitoring functions can be generated in the electronic control device in an advantageous manner, depending on the respective coding. By this means for example it is possible to use the same operating element in each power tool, even though for example it is planned to use the operating element to set different speed ranges. The electrical resistance of the operating element or a suitable control voltage is interpreted in the electronic control device according to the respective coding, so that a further simplification of the system is achieved by means of identical operating or monitoring elements.

Examples of the invention are illustrated in the drawing and explained in more detail in the following description. The drawing shows:

Fig. 1: a schematic, circuit-type diagram of a power tool with digital coding, connected to a power supply unit via a connection cable and

fig. 2: an analog coding in a sectional diagram.

In accordance with Fig. 1 a power tool 10 which can for example be in the form of an angle grinder, compass saw, circular saw, plane or the like, is essentially comprised from the electrical standpoint of an operating element 11 and a three-phase motor 12, which is preferably in the form of an asynchronous motor. The schematically illustrated power supply unit 13 is comprised essentially of an

electronic control device 14 in the form of a microcomputer and an electronic power section 15. In a connection cable 16 extending from the power tool 10 are located five lines, namely two control lines 17, 18 and three operating current lines 19 - 21 for supplying three-phase current to the three-phase motor 12 from the power section 15. The connection cable 16 is provided with a connector 22, which can be inserted into a suitably-designed socket 23 in the power supply unit 13. Of course the connector could also in principle be located on the power tool 10 or in the cable between the power tool 10 and the power supply unit 13.

In accordance with the state of the art indicated above, the electroni control device 14 in combination with the power section 15 amongst other things forms a converter to convert the mains a.c. voltage supplied to the power supply unit 13 into a three-phase voltage with adjustable, variable frequency and amplitude, with the adjustment effected in principle through a potentiometer.

In the operating element 11 is provided the series connection of an operating switch 24 to a speed controller 25 in the form of a potentiometer, and a PTC resistor 26. The external connections of this series connection are joined on the side of the PTC resistor 26 via the control line 18 in the power supply line 13 to earth or to a neutral wire and on the side of the operating switch 24 via the control line 17 to a power source 27, which is fed by an auxiliary voltaage U_h. At the interconnection point of the power source 27 and the control line 17 is applied a control voltage for the converter and for adjustment of the frequency and/or amplitude of the three-phas current feeding the three-phase motor 12, which is fed via an A/D transducer 28 of the electronic control device 14. The PTC resistor 26 makes a heat-conductive connection with the three-phase motor 12, as indicated by the line 29.

A control system of this kind is known for example from DE-OS 37 22 17 and will not therefore be described in detail. It is important only to note that by varying the control voltage through the speed controller 25, the speed of the three-phase motor 12 can be adjusted, and that in the event of an unacceptably high motor temperature, speed is reduced to a minimal value through the PTC resistor 26. Naturally, additional control and monitoring functions may be provided by means of additional resistors or other switching elements acting on the control voltage.

In a simpler version, it is also possible to dispense with this kind of remote control over the control lines 17, 18, in which case the operating switch 24 and if desired also the PTC resistor 26 act directly on the electric currents in the operating current lines 19 - 21.

Housed in the connector 22 is a digital memory 30, in the form of a serial PROM, preferably E^2PROM. For power supply it is connected to the control line 18 joined to earth and via a further power supply line 31 in the power supply unit 13 to an auxiliary voltage U_h. Two data transmission lines 32, 33 lead from the memory 30 to an I/O circuit 34 (input/output circuit) of the control device 14.

In this way, eight connection contacts not described in detail are provided at the connector 22, with eight corresponding mating contacts at the socket 23.

In the digital memory 30 is stored a tool-specific coding, preferably after final assembly of the power tool 10, when the latter has alread been provided with the connection cable 16 and connector 22. If the connector 22 is now inserted into the socket 23, then the data forming the coding is read-in serially via the data transmission lines 32, 33 and the I/O circuit 34 to the electronic control device 14. This coding is used to preset for example limit values for parameters such as speed, temperature, torque, electric current, electric voltage and the like, while control functions for the respective power tool connected can be preset for the electronic control device 14, such as speed range, a defined starting and/or braking pattern, operating characteristics, current/resistance compensation for adjustment in the vicinity of field weakening, etc. In this way, basic control and monitoring functions contained in the program of the electronic control device 14 can be modified by the coding data, so that power supply to the three-phase motor 12 over the operating current lines 19 - 21 is effected in accordance with the functions thus established and modified. This makes it possible to connect a very wide range of power tools to the same power supply unit 13, with electrical adaptation effected automatically in each case through the reading of the code data contained in the connector

The coding also acts consistently on the signals and control voltage of the operating element 11. In the electronic control device 14 these signals are converted or influenced in the manner of a functio

generator, depending on the coding read, so that all of the various power tools can be equipped with the same operating element 11. For example, the speed controller 25 then sets different speed ranges according to the particular coding.

As explained above, read-out of the coding from the memory 30 takes place automatically following insertion of the connector 22 into the socket 23. If an error occurs in reading, i.e. if data are read out which the microcomputer interprets as incorrect data, for example because they lie outside the preset and possible limit values, then the reading process is automatically repeated. After a number, preset by the read program, of unsuccessful attempts, a fault indication is given via the I/O circuit 34 to a visual or audible fault indicator 35, i.e. a tone or a preferably flashing light signal is generated. In order to repeat the reading process, the mains connector must be plugged out and back in again, or the power supply interrupted in some other way.

Memory areas of the memory 30 can also be used to hold characteristic data of the power tool such as equipment type, equipment number, date sold, owner, etc. The sales-specific data may be input shortly before selling via a suitable coding device. This data facilitates trouble-free processing of guarantee, repair and other service work. Finally, memory areas can also be used as fault memory, i.e. by means of a special fault program in the microcomputer, faults occurring during operation such as incorrect functions, incorrect signals or the like are detected and stored in the memory 30 in suitable data form. On inspection or repair, this data can then be read out in the workshop and analyzed. This makes it possible to determine faults in a simple manner, in particular faults which occur only sporadically.

Fig. 2 shows in sectional form a further development with analog coding. Here a connector 40 is inserted into a socket 41 of the power supply unit 42. Only those areas of these components which relate to the coding are illustrated. The coding is effected via resistors 43, 44 in the connector 40, which are connected on one side to one another and to the control line 18 joined to earth. The other two connections of the resistors 43, 44 are connected via lines 45, 46 to power sources 47, 48 in the power supply unit 42, which in turn are fed by the auxiliary voltage U_h. The voltages U_f and U_l dropped

at the resistors 43, 44 can be tapped at lines 45, 46 and fed to the control device 14.

One value or one function can be coded by each of the resistors 43, 44, for example resistor 43 can be used for the frequency or speed range for the three-phase motor 12, and resistor 44 for the maximum current value of a load or torque limitation. The corresponding coding voltages U_f and U_l are, in the case of an electronic control device in the form of a microcomputer, fed to it via an A/D transduce or in the case of analog evaluation to a suitable analog function generator.

This type of coding is especially suitable for a limited number of coding values or functions, since in each case only a single coding resistor is required. If the number of coding values or functions becomes too great, then the number of lines 45, 46 increases too much, so that the solution illustrated in Fig. 1 is to be preferred.

Finally, it is also possible to provide a mechanical coding, in which for example coding pins in the connector engage in correspondi recesses in the socket, there making or breaking an electrical connection.

Patent Claims

1. Power supply unit (13) with various power tools (10) connectable to it via a connection cable with a connector (22), and with an electronic control device (14) in the power supply unit (13) to control the power tools depending on one or more parameters, characterized in that a tool-specific coding device (30; 43,44), readable through an electric voltage signal from the electronic control device (14) via the connector (22; 40) for the power supply to the power tool (10) and in which a suitable control pattern for the respective power tool (10) is set, is provided in the connector (22; 40) or in the power tool (10) and that, through the coding device (30; 43, 44), limit values for parameters such as speed, temperature, torque, electric current, electric voltage and/or control functions for the respective power tool (10), such as speed ranges, starting and braking patterns, operating characteristics can be preset.

2. Power supply unit according to claim 1, characterized in that the coding device in the connector is designed as a mechanical coding device.

3. Power supply unit according to claim 1, characterized in that an analog, electrical coding device (43, 44) is provided.

4. Power supply unit according to claim 3, characterized in that resistors are provided as the coding device (43, 44).

5. Power supply unit according to claim 4, characterized in that the resistors (43, 44) connected on one side to an earth or neutral wire (18) have their other connection at connection contacts of the connector (10) and that the resistance values of the electronic control device (14) presetting the various coding functions are acquired via associated mating contacts.

6. Power supply unit according to claim 5, characterized in that the mating contacts are connected to power sources (47, 48) and that the voltages (U_f, U_l) read off at the mating contacts are supplied as coding voltages of the electronic coding device (14).

7. Power supply unit according to claim 1, characterized in that an electrical coding device in the form of a digital memory (30) is provided.

8. Power supply unit according to claim 7, characterized in that the memory (30) is designed as a serial memory with serial output of the various coding values or functions.

9. Power supply unit according to claim 8, characterized in that two connection contacts and two mating contacts are provided for data transmission.

10. Power supply unit according to any of claims 7 to 9, characterized in that reading of the coding can be initiated by plugging in the connector (22; 40).

11. Power supply unit according to claim 10, characterized in that, if an error occurs in the reading process, the process is repeated, and that a visual or audible fault indicator (35), actuated after a preset number of unsuccessful attempts, is provided.

12. Power supply unit according to any of claims 7 to 11, characterized in that the memory (30) is designed as a read-write memory, in particular E^2PROM.

13. Power supply unit according to claim 12, characterized in that a standard connector (22) permitting the reading-in or amendment of the coding before or after assembly, is provided.

14. Power supply unit according to claims 12 or 13, characterized in that a memory area of the memory (30) is provided to hold characteristic data such as equipment type, equipment number, date sold, owner or the like.

15. Power supply unit according to any of claims 12 to 14, characterized in that a memory area of the memory (30) is provided for fault signals occurring during operation.

16. Power supply unit according to any of the preceding claims, characterized in that the connection cable (16) is provided with control lines (17, 18) in addition to the power supply line (19 - 21), and that operation of the power tool (10) is effected by one or more operating elements (11) on the power tool (10) via the control line (17, 18) and the electronic control device (14) in the power supply unit (13), while suitable operating and monitoring functions can be generated in the electronic control device (14) depending on the respective coding.

FIG. 1

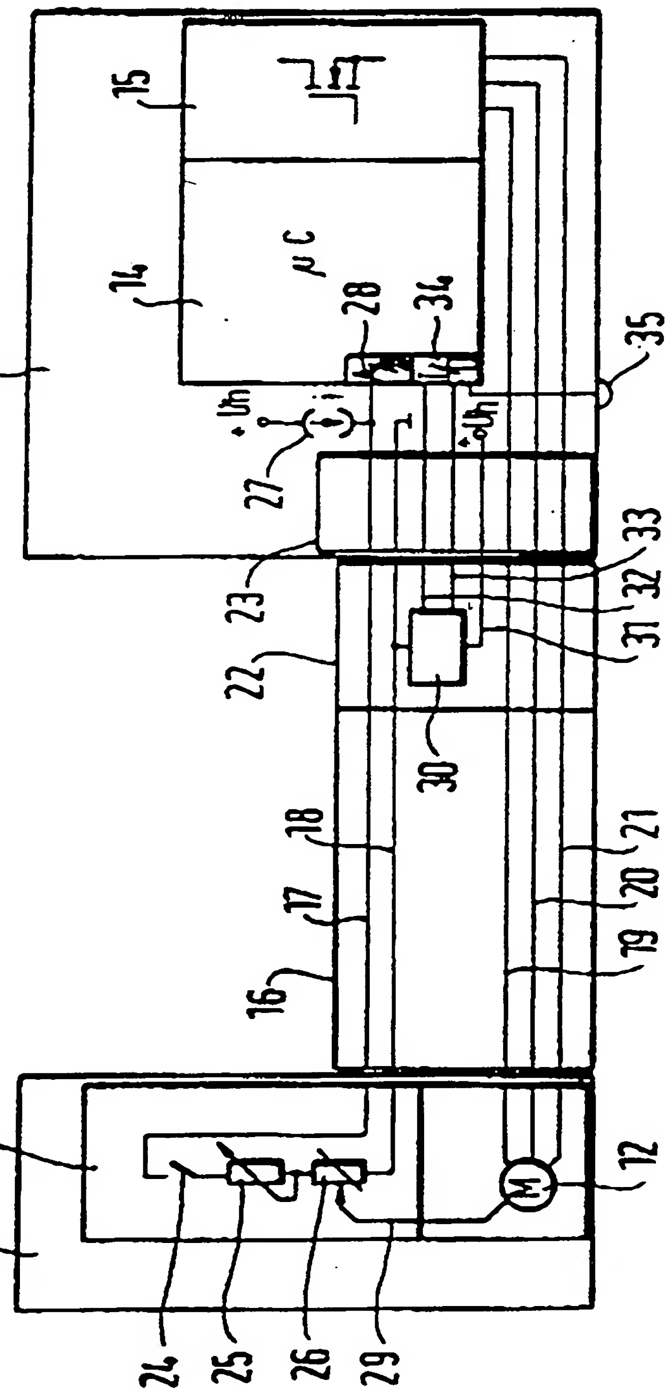
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FIG. 2